SOIL SURVEY OF GRAYSON COUNTY, TEXAS.

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DESCRIPTION OF THE AREA.

Grayson County, one of the northern border counties, lies in the eastern part of the central Texas belt and comprises an area of 1,010 square miles. It is bounded on the north by the Red River, the line between Texas and Oklahoma, on the west by Cooke County, on the south by Denton and Collin counties, and on the east by Fannin County.

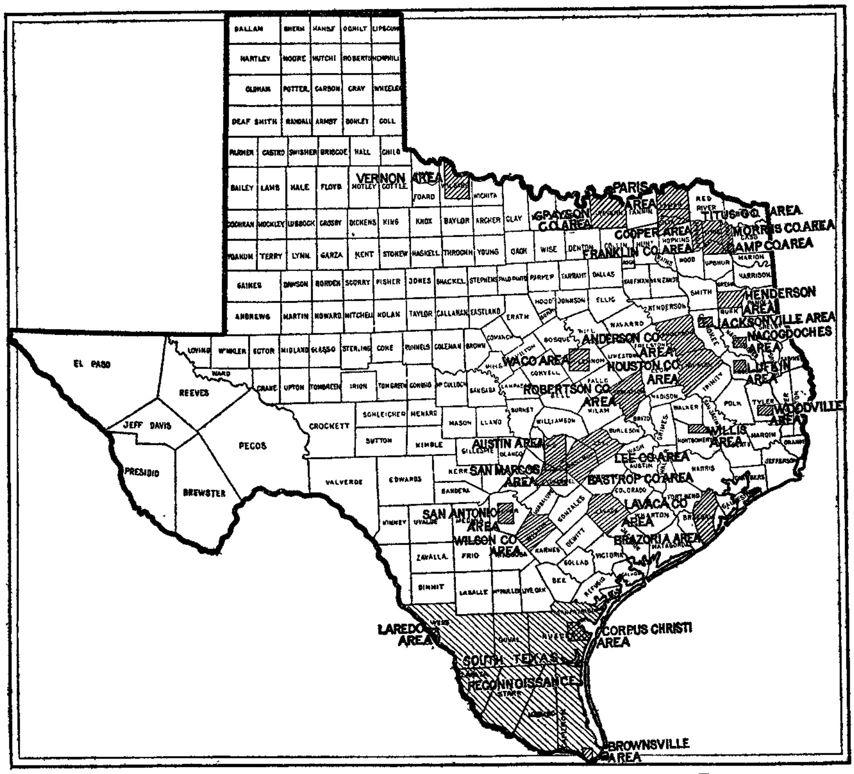

FIG. 31.—Sketch map showing location of the Grayson County area, Texas.

The topographic features vary from those of a rough, hilly country dissected and eroded by stream action to those of a level country. By far the greater proportion of the county would be considered gently rolling to rolling. The most broken areas are found in the northern and northwestern sections. A comparatively narrow strip paralleling

the Red River is composed of relatively high hills or bluffs, and is the most broken area in the county. These hills sometimes extend to the banks of the river, from which they rise almost abruptly to heights of 100 to 200 feet. There occur in this strip numerous short, but deep V-shaped valleys, formed by the action of small streams seeking an outlet to the Red River. The greater proportion of the more rolling or hilly country, however, is found in the vicinity of Denison. In the southeastern part of the county the topography varies from hilly to almost level, some of the more broken areas bordering Choctaw Creek and its tributaries in the vicinity of Sherman. Around Howe and Van Alstyne large areas of practically level country are found. East of Van Alstyne, or in the southeastern corner of the county, where numerous areas of Houston clay have been mapped, the topography along the stream is hilly and broken. There are some comparatively large areas northwest of Whitesboro that are almost level. The greater proportion of the county is prairie, but where the upland timbered areas are found the soil is generally sandy and the topography hilly. There are two main bodies of timbered land; one, a narrow strip following the western border of the county and extending entirely across it, another a broad ridge or chain of hills passing east and west through Denison. These areas are generally cut by small streams, and the soil is largely eroded, especially where it has been cleared and cultivated.

The altitude of Grayson County varies from about 520 feet to 900 feet above tide. The lowest elevation is in the Red River Valley and the highest in the county between Denison and Pottsboro. The elevation of the greater part of the area ranges from 650 to 800 feet.

Taking the county as a whole it has an excellent drainage system. The Red River receives the bulk of the drainage through minor streams, the most of which have their source within the county limits. In a general way a line drawn east and west in the vicinity of Sherman and Whitesboro marks a watershed. The important streams that drain the county north of this line and empty into the Red River are Sandy, Big Mineral, Little Mineral, and Iron Ore creeks. All of these streams flow to the north, with the exception of Iron Ore Creek, which takes an easterly direction and empties into the Red River near the northeast corner of the county. The most important streams south of this east and west line are Range, Buck, Sister Grove, and Choctaw creeks and the East Fork Trinity River. All of these streams pass out of the county in a southern or southwesterly direction, with the exception of Choctaw Creek, which follows a northeasterly course.

Grayson County is one of the oldest settled counties in the State, the first settlers coming principally from the Carolinas, Virginia, Georgia, and Kentucky. A very large percentage of the present

population are direct descendants of these early settlers, although many of the other States, especially in the central West, are represented. There are in the county some Germans, who have been there for a good many years, but beyond this there are very few foreigners. The negro population is principally confined to the towns.

Denison and Sherman, with populations between 15,000 and 20,000, are the principal towns in the county. Sherman is the county-seat and located near the center of the county. Denison is in the northeastern part, near the Red River, a distance of 10 miles from Sherman. Whitesboro and Whitewright are the two next largest towns, having populations of about 2,000. Other towns having a population ranging from 300 to 1,500 are Collinsville, Tioga, Sadler, Pottsboro, Southmayd, Dorchester, Gunter, Howe, Van Alstyne, and Bells. In addition there are a few little inland towns that have several stores.

The county is so well traversed by railroads that comparatively few of the farmers are located farther than 6 or 8 miles from a shipping point. The worst condition as regards transportation facilities is in the northwestern corner of the county. In this section a few of the farmers are 20 miles from a shipping point. The following railroads pass through the county: Missouri, Kansas and Texas, Texas and Pacific, Houston and Texas Central, Cotton Belt, and the Frisco. Besides these there is an interurban line extending from Denison to Dallas (Texas Traction Company). This line extends almost north and south across the county, passing through Sherman, Howe, and Van Alstyne.

Sherman and Denison, as well as some of the smaller towns, are on direct lines to Kansas City and St. Louis. They are also on direct lines to most of the larger cities in the State.

Thus far the county roads have received but little attention, although at present much interest is being taken in the construction of good roads, for which in most sections the necessary material is close at hand. In the black lands, where the roads in winter are frequently almost impassable, there is limestone to be had for surfacing. The same roads are generally good in summer, when the rainfall is not excessive. In the sandy sections of the county the sand and clay mixed make good roads.

CLIMATE.

The climate of Grayson County is equable, there being no long-continued periods of low or high temperature. The summers are long, but there is generally a breeze during the day and practically all of the nights are cool. Frequently during the winter months there occur sudden drops in the temperature. During such periods, locally known as "northers," the wind comes from the north, and is

usually accompanied by light rain, sleet, or snow. These cold waves only last a few days and do not seriously interfere with farming operations. Occasionally the "northers" last longer and are accompanied by such low temperature that some loss of live stock left without protection may occur. These cold snaps also have an important bearing on the fruit industry. The climate is such during an average year that cotton picking can continue until January and other farm operations can be carried on practically throughout the year.

The spring months are generally characterized by wind which sometimes causes damage to property. Hail also damages the crops occasionally during the same season, but the storms as a rule cover very limited areas. The last killing frost generally comes between March 1 and 15.

The following table shows the normal monthly, seasonal, and annual temperature and precipitation, as compiled from the records of the Weather Bureau station at Dallas:

Normal monthly, seasonal, and annual temperature and precipitation at Dallas.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	48	82	4	2.0	0.6	3.2	0.6
January	45	80	2	2.7	Trace.	2.7	0.8
February	46	85	−10	2.1	2.3	0.6	1.7
Winter	46			6.8	2.9	6.5	3.1
March	56	98	18	3.3	2.4	1.8	Trace.
April	66	94	31	3.5	1.8	2.4	0.0
May	74	98	36	4.2	5.7	7.5	0.0
Spring	66			11,0	9.9	11.7	Trace.
June	81	105	48	4.3	0.6	8.0	0.0
July	84	108	59	3.4	0.5	3.6	0.0
August	83	107	52	2.9	2.8	1.5	0.0
Summer	83			10.6	3.9	13.1	0.0
September	77	104	43	3.0	3.6	3.7	0.0
October	67	97	32	2.0	2.5	1.4	0.0
November	55	88	18	2.5	2.4	3.8	0.0
Fall	66			8.4	8.5	8.9	0.0
Year	65	108	−10	36.8	25.2	40.2	3.1

AGRICULTURE.

Grayson County was formed in 1847, but the first settlement took place about 1827, at what is now known as Kentucky Town, the

pioneers having come from Kentucky. The first settlers generally located near the streams on account of water supply, protection from prairie fires, and the existence of forests to supply building materials. They lived principally on game and grew in a crude way only enough grain for their own use. A little later and for a good many years large numbers of cattle were raised. The earliest farming operations deserving mention were those in the Red River bottoms. The black prairie lands were the last to be brought under cultivation, with the exception of some of the sandy timber lands. The prairie was not looked upon as a desirable soil, partly because it was believed to hold insufficient moisture during the growing season, but mainly because of the difficulty of breaking the heavy virgin sod with the crude implements of those early days. After the greater proportion of the available bottom lands had been put under cultivation and immigration increased, the black prairie was gradually encroached upon and it was discovered that after the sod was once broken and the soil put in good mechanical condition it became a superior type for cotton, corn, and small grain. Although Grayson County was one of the first in the State to be settled, its extensive farming and present prosperous condition have practically been developed since the civil war. There has been very little change from the first crops grown, and the prosperity of the county is founded principally on cotton and corn, although considerable wheat and oats have been grown for many years.

Grayson County is located at the northern end of what is known as the "black land" belt, which extends from the Red River on the north to the Rio Grande on the south. This belt is approximately 100 miles in width and 400 miles in length. An interesting feature of this country is the fact that the large cities of central Texas—Sherman, Dallas, Waco, Austin, and San Antonio—are built upon it. It is noted for its fertile soils, upon which a very large part of the wealth of the State is based. All of this area is not composed of the characteristic black lands. Numerous other types of soil are found, all having a more sandy nature and complementing nicely the heavier prairie soils. It has been but little over twenty years since the black prairie lands of Grayson County became generally recognized as good agricultural lands. Before this time the greater proportion of the prairie was used for grazing and cutting hay. Many large cattle ranches existed, but these tracts have gradually been cut up and put under cultivation. There are only a few of these large tracts left uncultivated at present, and they generally do not contain the most desirable agricultural soils.

The rapid development of the prairie lands is due to a certain extent to improved machinery. The one-horse plow is a thing of the past and the plowing is with two to six horses. With this more

thorough and more rapid breaking of the soil and the subsequent use of the cultivator, binder, etc., it is possible for one man to handle two or three times as much land as he did in former days. Until ten years ago very little attention was given to the finer points of farm management, such as the adaptation of certain crops to certain soils, the rotation of crops, and the proper methods of cultivating the various soils. The same crop was planted on the same field year after year, and the seed was put in without breaking the land. As land was cheap and plentiful almost all the farmers planted more than they could properly handle.

There are two rather distinct agricultural sections in the county, the "black land" belt, occupying the principal part of the country in the southern and central sections, and the sandy soils found in the northern and western parts. The black land is by far the most fertile section, and is especially adapted to cotton, corn, alfalfa, wheat, oats, and barley. In an attempt to realize a greater profit from the sandy soils the fruit and trucking industries have been introduced in this section. These industries are now practically in their infancy and there is a great opportunity for their development, soils and climate favoring the growth of early products of good quality.

Peaches are the principal fruit crop, and almost every farmer has at least a few trees. There are several young commercial orchards in the county, the largest, located near Whitesboro, contains over 500 acres, mainly peaches. Some plums, pears, apples, and grapes are also included, and pecan trees have been set out between the peach trees. The pecans should begin to bear well about the time the peach trees cease to give profitable crops. There is also another very large orchard near Collinsville.

The leading variety of peach is the Elberta, which is generally ready for market the first week in July. Another peach, the Early Wheeler, may be marketed as early as May 25. Peaches are shipped both to local and northern markets, and while prices vary with the crop, they generally bring from $1 to $1.25 a crate. Frost occasionally kills the fruit, but an average of three good crops in five years is secured. Almost all kinds of fruit—grapes, apples, plums, strawberries, and the bush fruits—give good yields. Pears grow well in the "black land" belt, but the other fruits do not succeed on the heavy soils. The Kieffer pear is the leading variety, mainly on account of its resistance to blight.

Sweet and Irish potatoes give excellent yields on the sandy soils, as do also cantaloupes and watermelons. One of the most important crops for such soil is the peanut. For the last few years a small acreage has been given to this crop and the industry is growing slowly. The sandy soils are in need of organic matter, and this crop

not only supplies this need, but, like the cowpeas, takes nitrogen from the atmosphere and leaves it in the soil. Both the yields secured and the prices obtained for the nuts are generally satisfactory. The vines make good hay, and the yields average from 1 to 2 tons per acre, while the peanuts make an excellent finishing feed for hogs. The hog industry is rapidly developing, and by raising alfalfa and peanuts the necessary feed may be supplied at little cost.

Alfalfa is especially adapted to the bottom lands along both the large and small streams. Almost every farmer has a little land adapted to this crop, and such land should not be used for any other. Alfalfa was introduced into Grayson County eight or ten years ago. Some of the farmers failed to get good stands when they first attempted to grow it and were discouraged. The soil must be put in the best condition and climatic conditions have to be favorable in order to get the plants well established. The seed may be sown in the spring or fall, but taking everything into consideration it is generally thought that fall seeding is the better plan. September and October are the best months to sow this legume. The greatest drawback to fall seeding is liability of drought and the resulting failure of the seed to sprout. March is the time for spring seeding and the chances are good for a stand, but there is danger that other grasses and weeds may smother the young plants. Crab grass is particularly bad in this respect, and if the field to be sown contains this grass it is almost useless to sow in the spring. By fall seeding the alfalfa seedlings may become large enough to withstand the encroachment the following spring. When sown in the fall the crop is ready for a first cutting about May 1. The yield the first year ranges from one-half to two-thirds of a crop or from 2 to 3 tons per acre. From 15 to 20 pounds of seed are used per acre. Seed can be purchased for 14 to 16 cents a pound.

The only types of soil on which alfalfa has been very successful is the Miller fine sandy loam, which lies along the Red River, and the bottom lands along the smaller streams. On the higher lands the alfalfa seems to suffer from a root rot very similar to that of cotton. The bottom lands are very fertile and the subsoil has a more open texture than the uplands, which allows the roots to go down much easier, and as the water table is generally near the surface the crop rarely ever suffers from lack of moisture. The more impervious subsoil is probably one of the causes for the poorer results with this crop on the uplands.

The boll weevil has greatly decreased the yield of cotton in the county. In 1908 there was a great decrease in the numbers of this pest and it is not making its appearance in the usual number this year (1909). There are hundreds of acres in Grayson County that would produce 1 bale of cotton per acre if it were not for the boll

weevil. The "green bug," which infested the grain fields for a time, has not been noticed during the past few years to any great extent. Because of these pests there has been a marked increase in the corn acreage, but with their decrease Grayson County will again approximate her large yields of cotton and small grains.

The size of the farms in Grayson County is gradually decreasing and the total acreage in farms increasing. The census returns show that in 1889 the average size farm was 117 acres, and in 1899 it had decreased to 91.3 acres. In 1889 the total acreage in farms was 507,363, while in 1899 it had increased to 526,240 acres. The acreage in corn in 1889 was 79,168, in cotton 74,238, in wheat 13,661, and in oats 23,533. By 1899 the area in corn was 104,668 acres, in cotton 114,077, in wheat 50,180, and in oats 61,824 acres. It will be noticed that in 1899 the acreage of cotton was greater than corn and that the acreage of wheat and oats had made a marked increase during the decade. The present condition would most likely show a greater acreage of corn than cotton and a decrease in the acreage of wheat and oats during the last few years. The gain of corn over cotton is due principally to the ravages of the boll weevil and the decrease in wheat and oats has been due to the injury done these crops by the "green bug." There has been a very important gain since 1900 in the production of fruit, truck, peanuts, cowpeas, and alfalfa. The Twelfth Census gives the acreage in alfalfa as 66, cowpeas 52, and peanuts 28 acres. At the present time many hundred acres are devoted to these products. This development has been on the sandy soils, except in the case of alfalfa, which is grown on the bottom lands intersecting both the sandy region and "black lands." The general development in the county can be appreciated when it is stated that the value of farm lands and improvements increased from $3,915,724 in 1880 to $13,732,290 in 1890.

Since 1900 there has been a slight business depression, mainly in the past few years. This has been caused by a series of poor crops, due to excessive rains. As a result, land values have decreased to some extent, but this is only temporary and one or two years of normal crops will put things on their former basis.

The great variation in the soils of Grayson County results in a wide range in the land values. The prices vary according to soil type, location, and improvements, and range from $10 to $75 an acre. The highest-priced land is found in the central, southern, and eastern parts of the county, and consists principally of the Houston black clay and Houston clay loam, the prices ranging from $35 to $75 an acre; the least valuable is the Crawford stony clay, Rough stony land, and the rough, hilly areas of the Susquehanna fine sandy loam. The Durant loam and Durant fine sandy loam are the highest priced of the lighter textured soils, the prices ranging from $20 to

$40 an acre. The Meadow (Sanders soils, undifferentiated) and Miller fine sandy loam bring from $35 to $65 an acre. The latter type on an average is worth from $40 to $60, the uncleared land selling for $20 to $25 an acre. Taking everything into consideration, a person can buy a good farm in Grayson County at from $30 to $45 an acre.

The greater part of the farming in Grayson County is done under the tenant system, only 33.7 per cent of the farms being operated by owners. Under the usual method of leasing land in the county the tenant gives the landlord one-third of the corn and one-fourth of the cotton produced. Very little land is rented for cash. In most cases the farms operated by the owners are comparatively small.

In 1900 the expenditure for farm labor was $284,080. The price of labor at present is about $25 a month without board, or $18 with board. Labor by the day receives from $1 to $1.25. The cotton choppers are generally paid $1 a day and the pickers, paid by the piece, receive 50 cents a hundred pounds.

Grayson County, with the great variety of soils, offers opportunities for almost any line of farming. With the systematic rotation of crops and the raising of more live stock, in which an interest is being revived, much would be added to the wealth of the county. Too much attention can not be given to the growing of peanuts and alfalfa. There are good opportunities in the county for producing dairy products, and more attention should be given to this industry. As a whole Grayson County is in a prosperous condition.

SOILS.

The soils of Grayson County are derived from formations of the Upper and Lower Cretaceous period. In the south-central and southeastern parts of the county are found the Taylor marl formation and the Austin chalk formation, the latter weathering into heavy black or yellow waxy clays, the Houston black clay and Houston clay. The topography of the county occupied by the Taylor marl and the Austin chalk formation varies from almost level to hilly. The surface drainage is good. In the west-central part of the county occurs the Eagle Ford formation. The limestone here seems to have weathered to a considerable depth and rarely ever outcrops, except in stream channels. In this section the Wilson clay is a prominent type of soil. The clays derived from the Eagle Ford formation are very similar in texture to the Houston soils, but the color is lighter. The topography of the county, resulting from the Eagle Ford formation, varies from level to rolling. The drainage is good, with the exception of local spots.

The next important formation and the most distinct in the county is the Woodbine. It is composed for the most part of unconsolidated ferruginous and argillaceous sands, and ferruginous sandstone fragments are frequently scattered over the surface. This formation is found in the western part of the county and in the vicinity of Denison. The greater part of the county here was at one time covered with a growth of post oak, red oak, and black-jack oak. The surface ranges from gently rolling to rough and hilly. When cleared and cultivated the resultant soils are easily washed and many badly eroded areas occur. The Woodbine formation gives rise chiefly to the Susquehanna fine sandy loam, the Susquehanna clay, and the Durant fine sandy loam. All of the above-mentioned formations belong to the Upper Cretaceous.

The Crawford stony clay is the result of the weathering of the Fort Worth formation—a hard limestone comparatively slow in breaking down. The section of the county it covers is very hilly and intersected by deep V-shaped valleys. The soil is washed away nearly as fast as it is formed, leaving the rocks exposed in many places and only a very thin layer of soil in others, and the greater part of the area occupied by this type is used only for grazing.

The overflow areas along the streams are grouped with the Recent, and the soils here are in the course of formation, sediments being deposited each year, the character of which depends on the kinds of soil through which the streams pass. The greater proportion of the Meadow is found along the Red River. Here the material consists principally of reddish fine sand and silt. Along the smaller streams it is principally dark clay, clay loam, and sand. The following table gives the names and areas of the several soils mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Houston black clay	137,088	21.2	Grayson clay loam	10,560	1.6
Wilson clay	100,864	15.6	Crawford stony clay	9,664	1.5
Susquehanna fine sandy loam	81,664	12.6	Houston clay loam	7,168	1.1
Durant fine sandy loam	46,848	7.2	Wilson loam	6,720	1.1
Durant loam	45,440	7.0	Rough stony land	6,528	1.0
Houston clay	44,096	6.8	Susquehanna clay	5,696	.9
Wilson clay loam	36,224	5.6	Crawford clay	3,520	.6
Trinity clay	34,176	5.3	Durant fine sand	1,600	.3
Meadow	28,736	4.5	Total	646,400	.....
Miller fine sandy loam	26,688	4.1			
Houston loam	13,120	2.0			

SUSQUEHANNA CLAY.

The Susquehanna clay consists of less than 4 inches of brown or reddish-yellow fine sandy loam, overlying a red or yellowish-red stiff, sandy clay containing iron concretions. Ferruginous sandstone fragments are scattered over the surface and small areas occur where the quantity is so great that cultivation is difficult. In places the clay comes to the surface and its mixture with the sand gives a true loam. Areas having a covering of more than 4 inches of sandy loam were mapped as Susquehanna fine sandy loam. All of the clay type was at one time a fine sandy loam, but erosion has removed the greater part of the sandy surface soil, leaving the red clay subsoil exposed. This process is still going on.

The subsoil varies in color from red to yellowish red, the lighter color being found at the lower elevations, gradually becoming darker as the elevation increases. Occasionally iron concretions are so numerous as to make the soil a gravelly loam, and fragments of ferruginous sandstone are also abundant in places.

Most of this type was at one time under cultivation, but some areas have been eroded to such an extent that they have been abandoned. Other portions are still covered with the original timber growth, principally red oak, post oak, and black-jack oak. Where the clay lies near the surface the land is more difficult to handle than where the sandy surface soil has good depth. When broken it forms clods and must be harrowed thoroughly to put in good tilth. If plowed too wet it bakes very hard. This changes the structure of the soil and some time is required to get it back into proper condition.

The greater proportion of the Susquehanna clay occurs in one large area about 3 miles southeast of Denison. The type covers a comparatively small area in the county. There are numerous areas in the Susquehanna fine sandy loam, almost every slope having a spot of it, but these are too small to be represented in the map.

In topography the Susquehanna clay ranges from hilly to rolling with occasionally level areas on top of the hills. Stony areas are generally found on the slopes or knolls where erosion has been severe. Excellent drainage is a characteristic of the soil, as it is usually traversed by many V-shaped valleys.

At present the greater part of this soil is not productive. It is in need of organic matter, which could be supplied by growing cowpeas or other legumes. In most cases also terraces, to prevent erosion, could be used to advantage. The soil responds readily to proper treatment, and with proper care in a few years would produce good yields of cotton, corn, and oats. At present the crop yields are very low.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Susquehanna clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21208	Soil	0.0	0.6	5.3	35.6	25.3	20.0	12.8
21209	Subsoil	.4	.4	1.9	17.3	16.5	20.6	43.0

SUSQUEHANNA FINE SANDY LOAM.

The Susquehanna fine sandy loam consists of 5 to 15 inches of gray or reddish-brown fine sandy loam, resting on a reddish-yellow to red sandy clay, in which are occasionally mingled small iron concretions. In some places the concretions are so numerous that they have given rise to a gravelly loam. Such areas generally occur along slopes where as the result of erosion the soil is thin. Ferruginous sandstone is frequently found scattered over the surface and in occasionally small areas the fragments are so numerous that cultivation is almost impossible. In the lighter colored areas the soil has a tendency to be looser and more incoherent than in the areas having a reddish-brown color. In case of the latter areas the texture in depressions frequently resembles a loam. The nearer the subsoil is to the surface the more loamy and the darker the soil.

The subsoil has quite a wide range in color, passing from yellow, with a slightly reddish tinge, to brick red. The greater part of it is, however, a pale red. All these colors may occur within areas of limited extent, as may be clearly seen in road cuts. Both the soil and subsoil vary somewhat in color with the topography, in the same way as the Susquehanna clay. The lower lying areas are lighter in color; the tops of the knolls a brick red. As a general rule the latter color does not occur in extensive and uniform areas.

The depth of the soil also varies with the topography, the shallower soil being found on the knolls and slopes. There are numerous small areas consisting of only a few acres where the sand has been blown or eroded away, giving rise to a clay soil. Had these areas been large enough to be represented in the map they would have been classified as Susquehanna clay. The texture of the sand in the more level areas is somewhat finer than at higher elevations and in more rolling areas. This is probably due to the assorting action of wind and water, finer material having been moved from the more exposed hills into the level areas.

The topography of the Susquehanna fine sandy loam varies from rolling to rough and hilly. The most rolling areas are generally found near or bordering the streams. The drainage is good. In fact over a large part of the type it is too rapid and erosion is severe.

This type occurs in the vicinity of Denison, where it occupies a high, broad ridge or broken ridges, with a maximum width of 5 miles, extending east and west and along the western boundary of the county and in the northwestern part of the county. The areas in the last-mentioned section generally occur as a chain of ridges or hills following the streams, and the larger the streams the broader the areas. The topography is in general hilly, and some of the country is so rough that the soil will probably not be cultivated for many years. Small areas on the steeper ridges and knolls are very stony, the roughest of such areas have been represented by symbol. The most broken areas encountered were northwest of Cedar Mills, bordering the Red River. Here the hills are high and the streams have cut deep gorges.

A comparatively small percentage of this soil is under cultivation and a large part of it is covered with first-growth forest, consisting principally of red oak, post oak, and black-jack oak. The soil varies greatly in value for agriculture. Where it is not too rolling or too badly eroded it produces good yields of cotton and corn, but on the average the yields are low, corn giving 15 to 30 bushels and cotton about one-third bale per acre. The soil responds quickly to fertilization. By the use of cowpeas, peanuts, or other legumes, winter cover crops to prevent erosion, and by practicing a suitable rotation it could be made a productive type. The slopes should be terraced to prevent washing. With such attention some areas of the type would become an excellent peach soil. Farms on the Susquehanna fine sandy loam are small and much attention is given to growing orchard and small fruits and truck, such as cantaloupes, potatoes, and tomatoes. This use of the land is comparatively recent.

The following table gives the results of mechanical analyses of samples of the soil and subsoil:

Mechanical analyses of Susquehanna fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21206	Soil	0.4	0.6	1.7	32.5	19.8	33.6	11.1
21207	Subsoil	.2	.3	1.0	48.4	5.6	12.7	31.8

WILSON LOAM.

The Wilson loam is an intermediate type between the Houston black clay and the Houston loam on the one hand and some of the sandy types on the other. The soil varies from a brown clay loam to a heavy yellowish-brown fine sandy loam. The areas are patchy, but taken as a whole the loam soil predominates. The soil has an average depth of 8 inches, where it rests on a subsoil of sticky, heavy, yellow clay, occasionally containing a small proportion of fine sand. The subsoil is often exposed in spots, owing to erosion.

In topography the Wilson loam varies from hilly to gently rolling. The soil is darker and contains less sand on the hills than it does along the slopes and in the gently rolling country. The greater part of the area of this soil is eroded and in many places the gullies are deep and extensive.

Practically all of the Wilson loam occurs in one area about 3 miles east of Southmayd. It extends north and south about 6 miles and ranges from one-half mile to 2 miles in width. The east side of this area, occupying the slope along the hills of the Houston soils, is the highest. The western side is lower and would be level if it were not for gullies formed by the rapid flow of water from the hills. These gullies divide the soil into many little knolls, resulting in a comparatively rough surface. This soil is on the edge of what appears to have been an old lake bed.

Very little of the Wilson loam is suitable for agriculture, and only a few small areas are cultivated. It gives small yields, and the principal use at present is for grazing.

WILSON CLAY LOAM.

The soil of the Wilson clay loam consists of about 10 inches of dark-brown clay loam. The subsoil to a depth of 30 inches varies from a yellowish to dark-yellowish stiff, tenacious clay, which is practically the same as the subsoil of the Wilson clay. Decomposed lime nodules are often scattered through the subsoil, resulting in a peculiar white spotted appearance. Partially decomposed limestone fragments are occasionally scattered over the surface, but never in large enough quantities to interfere with cultivation. These two Wilson soils are closely associated, and in some cases where the gradation zone is rather broad it is rather difficult to draw the line of separation.

Where the Wilson clay loam borders the sandy soils, such as the Durant fine sandy loam and the Susquehanna fine sandy loam, the soil contains more fine sand and is lighter both in texture and color than the main body of the type, in some places being almost a loam. The subsoil of this phase is a yellow clay containing a very small

proportion of fine sand. In areas bordering the Susquehanna fine sandy loam the subsoil occasionally has a slightly reddish tinge.

This type and the Houston black clay are somewhat similar in general appearance, but the latter usually has a little darker color, is a little more loamy, and also more productive.

One of the largest areas of the Wilson clay loam is found about 5 miles northwest of Denison and another body occurs around Ethel. There are also comparatively important areas east of Tioga and west of Gunter. In general the type is confined to the central-western section of the county. In origin the Wilson clay loam is the result principally of the intermingling of the materials giving the Wilson clay and the sandy soil types.

The surface of this soil varies from rolling to almost level. Some of the more level areas are inadequately drained in wet seasons, and there are a few small depressions that require artificial drainage, but in ordinary years the most of the type is well drained.

The Wilson clay loam is a more desirable soil than the Wilson clay, principally on account of the greater ease of cultivation. It can be plowed sooner after a rain, and crops do not suffer as much during rainy seasons. Corn, cotton, and oats do very well upon this soil. Corn yields 30 to 45 bushels, cotton from one-third to one-half bale, and oats from 40 to 50 bushels per acre.

The texture of the soil and subsoil, as determined by mechanical analysis, is showed in the table following:

Mechanical analyses of Wilson clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21196	Soil	0.2	0.3	1.3	11.2	26.4	33.1	27.0
21197	Subsoil	.0	.6	1.3	10.4	17.9	43.1	26.5

WILSON CLAY.

The surface soil of the Wilson clay consists of 10 to 15 inches of very heavy clay varying in color from a dull yellow to dark brown or almost black. The subsoil is very similar to the soil in texture, being somewhat more tenacious. As it contains a lower percentage of organic matter the color is lighter. Partially decomposed lime concretions are frequently scattered through the subsoil. The transition from soil to subsoil is very gradual both in texture and color. Sometimes level or flat areas occur near the streams, where the soil extends to a depth of 18 inches and has a slightly grayish tinge. The subsoil in such areas is a dark bluish color, and sometimes mottled. The yellow-colored subsoil occurring in the main body of the type is rarely

ever reached in this phase at a depth of 36 inches. The intermingling of dull yellow and darker colored soil in fields of the Wilson clay is very noticeable along the slopes where the fields appear to be striped alternately from yellow to dark, the stripes extending up and down the slopes. This difference in color seems to be due to erosion, the original darker colored surface soil having been removed, exposing the yellow subsoil. The surface is generally smooth, and for this reason it does not appear to have been subjected to any great erosion. In the more level areas the surface color is also somewhat uneven, but the yellow occurs in spots rather than in stripes. This difference in color between the soil and subsoil is very noticeable in roadside ditches, the change being very abrupt.

In areas that have not been cultivated regularly and are used only for grazing, the surface is frequently very uneven, owing to a succession of very small depressions and knolls. The depressions are only 4 to 10 inches below the knolls and the broadest of them only a few feet in diameter. Such land is locally known as " hog wallow " land. This condition is probably due to cracking—a characteristic of this soil. When very dry small particles of the soil break off and fall into the cracks, and when the soil becomes suddenly wet the accumulated fine material expands, causing the surface between the cracks to bulge. In the uncultivated areas cracks several feet deep and often 2 or 3 inches wide are formed. In the cultivated fields the soil does not crack to such a marked extent.

The darker colored phase of this soil is the more fertile and also the easier to cultivate. Where the yellow spots are very numerous the soil is the most difficult type in the area to handle. It is very tenacious and sticks to the plow. The clods are hard and difficult to break and the soil never pulverizes as does the Houston black clay. A considerable area of this type is used for grazing, because it is so refractory. There are also a great many fields covered with Johnson grass, which is used for hay. Occasional small spots of Houston black clay, too small to represent, occur in this type.

The topography varies from rolling to level. The drainage in seasons of normal rainfall is good, but in wet years crops are badly damaged by excess of moisture, especially on the level areas. Water is practically all removed by surface drainage, as the impervious clay inhibits movement downward through the soil.

The Wilson clay occupies an area next in size to the Houston black clay. The greater proportion of it is found in one large body in the western part of the county. This area begins a little north of Southmayd and extends across the county line between Tioga and Gunter. It has an approximate length of about 18 miles and a width of 5 miles. The type is mainly derived from the Eagle Ford formation. Cotton, corn, oats, and wheat are crops that give returns

on this soil, and of these it seems best adapted to oats. The average yield of corn ranges from 30 to 40 bushels, cotton one-third to one-half bale, oats from 35 to 55 bushels, and wheat from 12 to 15 bushels per acre.

The following table gives the results of mechanical analyses of the soil and subsoil of the Wilson clay:

Mechanical analyses of Wilson clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21198	Soil	0.0	0.4	1.9	7.3	8.3	49.8	32.2
21199	Subsoil	.5	1.3	.5	2.1	2.4	63.7	29.4

CRAWFORD STONY CLAY.

The soil of the Crawford stony clay varies from a dark-brown to almost black clay or clay loam, with a depth of about 8 inches. The subsoil is a stiff yellow tenacious clay. Both the soil and subsoil are very stony. The stones range from small particles to large fragments, and rock outcrop is also frequent, especially along the slopes. This type is so stony that it is very seldom possible to bore a hole over 18 inches in depth, and in the majority of cases 12 inches is about the limit. Many small areas have a comparatively small quantity of rock fragments on the surface, but the underlying limestone is encountered at a slight depth.

The main body of the Crawford stony clay occurs in one large area north of Denison. Smaller areas are found along the contact with the Susquehanna fine sandy loam. Sometimes small quantities of ferruginous sandstone are mingled with the limestone fragments.

An extremely rough and broken topography marks the areas of this soil. This configuration is due largely to the work of erosion done by the numerous small streams which intersect the area. The streams have deep V-shaped valleys, and along the slopes of the hills there is only a shallow covering of soil over the parent limestone, and rock outcrops are numerous. The type is well drained by the many small stream valleys and deep ravines between the hills. The Crawford stony clay owes its origin to the weathering of the Fort Worth formation.

Owing to the topography of the type the soil is washed away almost as fast as it is formed. There are a few small, cultivated areas on the tops of the broader hills, but the yields are small and farming is difficult. The type supports an excellent growth of grass, except along some of the slopes, and practically all of it is used for grazing. This is practically the only value the greater proportion of the type has for agriculture. There is some timber along the streams.

MILLER FINE SANDY LOAM.

The soil of the Miller fine sandy loam consists of a loose, fine sandy loam, ranging in depth from 12 to 20 inches, with an average depth of 15 inches. The color for the most part is gray to reddish brown, but areas are sometimes seen in which the surface has a darker color, as a result of the incorporation of larger quantities of organic matter. In such places the soil is more nearly a loam in texture. The mineral components of the subsoil are practically identical with those in the soil both as regards texture and structure, but the subsoil carries less organic matter and is therefore lighter colored. The color gradually becomes lighter and the organic matter decreases as the depth increases, and frequently at a depth of 30 inches a yellow sand is reached. Often both the soil and subsoil contain a somewhat higher percentage of silt and in depressions the subsoil sometimes contains very little sand, being almost a pure silt of reddish and chocolate color.

The Miller fine sandy loam, being a river deposit, naturally lacks uniformity. It was much more uniform before 1908 than it is at present. An overflow in that year covered portions of this type that had not been flooded for many years. Large deposits of sand were laid down in some places and in others the soil was washed off ruining several valuable farms. The most notable of these sand deposits is near Denison, while some farms have small sand mounds scattered over them, and in places 20 to 50 acres are covered in this way, the sand mounds, which are from 1 to 5 feet high, having the appearance of small sand dunes.

In the more extensive areas of the Miller fine sandy loam there are sometimes three terraces. The first one bordering the river varies from a sand near the stream to a light sandy loam farther inland, the soil gradually becoming heavier as the distance from the river increases, until the second terrace is reached. The second terrace is generally a dark-gray heavy sandy loam, rich in organic matter. Here the subsoil is practically the same as the soil, the only differences being a little lighter color and a lower content of organic matter. The third terrace is a reddish-gray fine sandy loam, about 12 inches in depth, underlain by a slightly lighter colored sandy loam that sometimes is slightly sticky. The second and third terraces occur in some of the larger bends of the river and are only narrow strips. The third terrace has never been known to be flooded.

Notwithstanding the lack of uniformity in this soil, the main differences over the greater part of it are differences of color and not of texture. The larger proportion of the gray soil is found in Preston Bend and west from the junction of Choctaw Creek with the Red River. Larger areas of this type are found near Preston Bend,

Willis Ferry, Orlena, and northwest from Ambrose. The type does not form a continuous strip along the river, but is broken here and there by bluffs coming to the water's edge.

Although the greater portion of this type has good drainage there are a few depressions or sloughs in the broader bottoms where the soil is too wet for cultivation. The poorly drained areas can be easily reclaimed by open ditches, or underdrains, as there is always sufficient fall to the river. Some areas have been drained by ditching. The moisture condition of the type as a whole are regulated to a marked extent by the structure of the soil, which is sufficiently open to absorb readily much of the rainfall. The water table is generally found at a depth of 2 to 3 feet even in dry weather, which is near enough to enable capillary action to bring the moisture within the reach of crops, so that they rarely ever suffer from drought.

The Miller fine sandy loam is a result of deposits laid down by the Red River, and, except those areas on the third terrace, is in course of modification at the present time.

This type of soil was the first to be cultivated by the early settlers, principally on account of its productiveness and its situation near the river, which then was the only means of transportation.

Some areas of this soil are still covered with the original timber growth, which consists principally of cottonwood, ash, pecan, and elm.

There is no better soil in Grayson County than the Miller fine sandy loam. It is perhaps best adapted to corn, but is well suited to the production of all the crops grown in this part of Texas. Corn, which leads in acreage, yields from 40 to 70 bushels, and cotton on an average of about one-half bale per acre. The type is also well adapted to trucking, and upon areas near shipping points considerable quantities of potatoes, tomatoes, cabbage, cantaloupes, and other vegetables have been grown in the last few years. It is extremely well adapted to alfalfa, which produces on an average from 4 to 5 tons per acre, and there is an excellent opportunity for hog raising in connection with alfalfa, corn, and peanuts, the last of which should give large yields with even ordinary care. Third-terrace areas are doubtless well adapted to peaches and the other kinds of fruit grown in the locality.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Miller fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*	*Per cent.*
21220	Soil	0.2	0.7	3.1	28.6	22.7	36.6	8.0
21221	Subsoil	.0	.6	2.8	26.2	28.8	23.5	18.2

HOUSTON CLAY LOAM.

The surface soil of the Houston clay loam consists of a mellow dark-brown clay loam with a depth of 10 inches. Immediately below this is a brownish-yellow sticky clay. The type is remarkably uniform, and the only variations are a slightly heavier texture and a little greater or less depth in some places than in others. Occasionally a few limestone fragments are scattered over the surface, but as a rule the soil is free from rock and the underlying limestone lies at a considerable depth.

In origin the Houston clay loam is a residual soil derived through weathering from a limestone—Austin chalk formation. The type occupies a much lower elevation than the country to the north of it and it is probable that some material has been brought down from this hillier region. It also appears from the topography that the soil may have been influenced during some earlier time by Choctaw Creek, especially in case of those areas near that stream. A few areas of this type, too small to be shown in the map, occur in the Houston black clay. Such areas are found near Choctaw Creek. Along the boundary between the Houston clay loam and the Durant loam the soil contains a little more sand, the gradation zone being broad.

Where the streams have cut through this type the underlying limestone is sometimes exposed. In such cases there is generally a narrow strip on each side of the stream where the soil is very thin, or has been entirely removed, exposing the yellowish-brown subsoil. Here there are often a few limestone fragments scattered over the surface.

Many small streams traverse the area of this soil, and with the exception of an occasional small depression, which is of no importance, it has excellent drainage. The drainage all flows into Choctaw Creek.

The topography of the Houston clay loam varies from gently rolling to level. In general, beginning at the northern edge of the area, where it borders the Houston black clay, there is a very gradual slope to Choctaw Creek. So gradual is this slope in places that the soil merges into the bottom land without a perceptible change of level.

While the Houston clay loam occupies a comparatively small area, it is a very important soil type. It is one of the most productive soils in the area, and some areas of it are more desirable than the Houston black clay on account of greater ease of cultivation.

The type is well adapted to cotton, corn, wheat, and oats. Cotton yields from one-half to three-fourths bale, corn from 35 to 55 bushels, oats 40 to 60 bushels, and wheat from 12 to 20 bushels per acre. Considerable nursery stock is grown and the soil seems to be well adapted to this purpose.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Houston clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21200	Soil	0.2	0.3	0.9	6.1	22.3	46.2	24.0
21201	Subsoil	.0	.5	.5	5.4	23.4	48.3	21.7

HOUSTON BLACK CLAY.

The Houston black clay is composed of 10 to 15 inches of brownish-black to jet-black clay, resting on a subsoil very similar to the soil in texture and of dark-gray color, frequently with a bluish tinge. The soil, though containing more organic matter than the subsoil, is rather less tenacious and impervious. In general the surface soil is uniform in color and texture, but the subsoil shows some variation, the differences being related to the depth of the underlying limestone. Where the bed rock lies within 4 or 5 feet of the surface the 3-foot profile includes a layer of yellow or grayish clay beneath the dark clay, and this grades into the partially decomposed limestone.

On slopes where the soil has been partly eroded away the depth of surface soil is in many places not more than 6 or 8 inches, the remainder of the profile being as described.

Mingled with both the soil and subsoil are small lime concretions varying from very small particles to pieces 1 or 2 inches in diameter. There are also occasionally a few fragments of limestone scattered over the surface.

In texture this soil is one of the heaviest types in the county. When wet it is very sticky and clods form when plowed in this condition. These bake very hard and it requires long continued harrowing to put the fields in condition. On the other hand, if the soil is in the proper condition when plowed, the clods pulverize readily and a good seed bed is secured with comparatively little trouble. When properly cultivated the soil breaks up into small granules and has the appearance of black gravel and sand.

Almost the entire area of the Houston black clay is adequately drained during years of normal rainfall. In seasons of excessive rainfall crops on the level areas and in small depressions are sometimes damaged by too much water. While the surface drainage is generally satisfactory, the marked capacity of the soil for water often renders it difficult to till. In topography the Houston black clay varies from level to hilly, the greater proportion being gently

rolling. The hilly areas are generally found along the streams which flow in deep-cut valleys, showing outcrops of the solid limestone.

With the exception of Choctaw Creek the streams that drain this soil are generally dry during the summer months. The Houston black clay is a residual soil derived through weathering from the Austin chalk and Taylor marl formations. The former gives rise to the western part of the type and the latter to the eastern part. The soil is naturally rich in humus.

Practically all this type is found east of a north and south line passing through Gunter and Southmayd, though there is one comparatively large area west of Gunter. Very little of it appears north of Sherman. It is found in large and uniform areas, the most conspicuous one extending south from Sherman through Howe and Van Alstyne and reaching the eastern limit of the county. These broad areas are broken principally by the Houston clay.

Practically all the Houston black clay is under cultivation and is regarded as one of the most productive types in the area. Uncultivated areas generally have a growth of Johnson grass which is cut for hay, giving yields of 2 to 3 tons per acre. General farm crops are well suited to this type of soil, and cotton, corn, wheat, and oats form the principal products at present. Cotton gives an average yield of one-fourth to three-fourths bale per acre, corn from 40 to 50 bushels, oats 40 to 60, and wheat 12 to 18 bushels. Many of the best farmers secure yields considerably greater than those stated.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Houston black clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21202	Soil	0.0	0.3	1.1	5.6	8.6	57.0	27.5
21203	Subsoil	2.0	1.6	.6	2.2	8.6	58.9	26.2

HOUSTON CLAY.

The soil of the Houston clay varies from a brownish-gray to an almost white clay, with an average depth of 8 inches. Both the depth and color vary with the topographic position. The darker colored areas occupy shallow depressions and the more level places, while the color of the soil on the slopes is usually of a lighter shade, and from a distance, especially where surrounded by Houston black clay, it appears to be almost pure white.

One of the characteristic features of the type is the presence of partially decomposed limestone fragments. These are scattered over

the surface and are generally most numerous on the knolls and slopes, where extensive erosion has taken place. Such areas cover only a few acres and would be mapped as stony loam were they large enough. The soil in such places is shallow and small areas occur where the chalky material of the lower subsoil has been turned up, giving the surface a very light color. The rotten limestone also shows at the surface in spots where the soil has been eroded off.

The subsoil of the Houston clay varies from a stiff brownish-gray to a light-gray clay, which becomes lighter in color and texture as depth increases, grading at an average depth of 20 to 30 inches into a white, silty material composed of a rather soft limestone. This generally extends downward 1 or 2 feet before the limestone becomes hard enough to offer resistance to plant roots. The transition of the overlying clay into this material is gradual. In many places, especially in case of the smaller areas, it was a question whether to classify the soil as this type or as the Houston black clay, the color sometimes being halfway between the typical color of the two. In other places the surface is spotted gray and black, and such areas were mapped as the type which seemed to predominate. There were many spots of the Houston clay that were too small to be shown in the map.

This type is a residual soil derived through the Austin chalk and Taylor marl formations. It is probable that the areas it occupies were at some former time Houston black clay and that erosion has been the cause of the present differences between these two soils. They are always closely associated, and as a rule the clay occurs on the steeper slopes where erosion would naturally be most severe.

Areas of this soil occur in the central, southern, and southeastern parts of the county. Almost every stream will have at least a small area along some part of its course. The greater proportion of the type is found in the southeastern corner of the county along Cedar, Mill, Sister Grove, and other creeks.

In topography the Houston clay ranges from rolling to rough and hilly. The surface is frequently badly eroded and broken by ledges of outcropping limestone. Owing to these conditions a very small percentage of the soil is cultivated. When wet this soil is very sticky and in drying the surface bakes hard. After it is plowed and the clods are broken it becomes quite loose and acts somewhat like a silt. The areas that are level enough and not eroded make a good soil for cotton, corn, and oats, although such areas are generally comparatively small. It is rather hard to form accurate estimates of the yield, as the productiveness of the soil varies widely in different areas, but as an average for the whole type, corn will yield from 25 to 40 bushels per acre, cotton from one-third to one-half bale, and oats from 35 to 50 bushels.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Houston clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21204	Soil	0.4	1.3	1.4	13.5	13.0	49.5	20.7
21205	Subsoil	.0	1.0	.6	9.0	12.5	47.5	29.4

HOUSTON LOAM.

The Houston loam varies in character more than any other upland soil in the area, for the reason that it represents a broad gradation from the black prairie soils to the timbered sandy soils. The surface material ranges from a heavy fine sandy loam to a comparatively heavy loam. This difference is due to position with respect to contiguous soils. The areas bordering the light sandy soils contain larger quantities of sand and those along the contact with the clay soils more clay.

The predominating phase of the type is a dark-gray or light-brown loam, which extends to a depth of 10 inches, beneath which is found a yellowish-brown slightly sandy clay or a stiff drab or in some cases almost black clay, very similar to the subsoil of the Houston black clay. The type is very spotted, all phases of the soil sometimes occurring in patches in a single field.

Besides the intermingling of the sand and the Houston black clay in the formation of the Houston loam, it has also been modified by deposits laid down by Postoak Creek in the vicinity of Sherman. Here along the banks of this stream there are occasionally small areas that are quite sandy.

As a whole the type is well drained, the only exceptions being a few small depressions which could be easily drained either by open ditches or tiling.

Three comparatively large areas of this type occur in the county, the most important of which is the one upon which Sherman is located. Another lies a little northeast of Sherman Junction and the third is found near the town of Bells.

The most fertile phase of the type lies along its contact with the Houston black clay. Here the soil is heavier and it contains more organic matter. Even along the Houston black clay the heavy and light phases alternate frequently. The town of Sherman is fortunate in being located on a light-textured soil of this character. The soil is excellent for early truck and fruit, as it warms up early in the

spring. It is easily worked at a time when the heavier soils are too wet to cultivate. The local market is supplied by considerable quantities of truck from this soil and the acreage is gradually being increased. It is also a good peach soil and many trees have been planted in the past few years. Considerable nursery stock is grown. The type, especially the sandy phases, could be used to better advantage for these crops than for any others, but at present the greater part of the area under cultivation is devoted principally to cotton and corn. The average yield of cotton is about one-half bale and of corn 30 to 40 bushels per acre.

GRAYSON CLAY LOAM.

The Grayson clay loam consists of 8 to 10 inches of dark-gray or brown clay loam, underlain to a depth of 3 feet by a stiff yellow, sometimes mottled, clay or silty clay.

This type of soil is locally known as "flats," and covers an area resembling an old lake bed. It is 9 miles long and averages about 1½ miles in width, extending north and south between Southmayd and Gunter. At the eastern boundary there is generally an abrupt change in topography, the surrounding soils being hilly. Along the foot of these hills there are spots that contain considerable sand, which makes it appear as if there might have been here an old shore line. The western boundary of the type does not present such strong evidence of this condition. In most places the rise in elevation is gradual and only occasionally is abrupt, but where the latter condition is found the sandy material often occurs as on the east side.

The surface of the Grayson clay loam is flat. Small ridges or knolls, slightly elevated above the adjacent soil, are scattered over the area. The depth of the soil on these ridges is less than that of the main type and both the soil and subsoil are lighter in texture and color. The mottled subsoil is found in the lower parts of the area, and quite often in these depressions the soil is strictly clay. The rapid drainage from the hills in places has cut deep gullies through this type for a considerable distance. In a number of places in these gullies seams of gypsum were observed.

Practically all of the type is uncultivated, mainly on account of the lack of drainage. Occasionally a strip along the edge of a small ridge is under the plow, but the crops are almost a failure during a wet year. There is a certain amount of alkali in this soil, but it is noticeable only in small spots. Water stands on this soil in many places in the winter, and it is almost impossible to cross it with a team except in dry weather. Drainage could be established, but the expense at present would be too great to make it practicable. There are a few small streams and sloughs passing through the type. At present practically all the type is used for grazing.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Grayson clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21216	Soil	0.0	0.4	0.9	13.6	30.9	32.7	21.4
21217	Subsoil	.1	.5	.9	16.0	25.4	33.7	23.1

DURANT FINE SAND.

The Durant fine sand consists of 3 or 4 inches of light-gray fine sand, underlain to a depth of 30 to 36 inches by a reddish-gray or yellowish-gray fine sand. Occasionally at a depth of 30 inches a red clay like that underlying the Susquehanna fine sandy loam is encountered.

The type occupies a smaller area than any of the other types mapped. The principal development is found around Collinsville.

This soil has been formed by wind action and occurs in very small spots in the Susquehanna fine sandy loam and Durant fine sandy loam, the sand being pratically the same as that found in those types. In the Durant fine sand the finer particles have been blown away, leaving practically pure sand. Drainage is uniformly good; in fact the texture is so open that the moisture held for crop use is insufficient. The soil is still being drifted by wind and is of very little importance agriculturally, being naturally unproductive. It is easily cultivated and better adapted to truck than any other crops.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Durant fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21210	Soil	0.1	0.4	5.8	69.1	9.6	11.6	2.9
21211	Subsoil	.0	.4	5.6	74.6	8.4	7.7	2.5

CRAWFORD CLAY.

The Crawford clay is a brown or chocolate-colored clay with a depth of 10 inches, underlain by a lighter colored stiff clay. Frequently at a depth of 30 to 40 inches the subsoil becomes more friable and has a brownish-gray color, this being due to the nearness of the rotten limestone which underlies this type.

In color and texture the surface soil is comparatively uniform, the only variation being the occurrence of some areas where the clay is slightly loamy. The subsoil often contains white spots, caused by partially decomposed lime nodules. Fragments of limestone are often scattered over the surface and are most numerous along the slopes.

In topography the Crawford clay ranges from slightly rolling to almost level. The drainage is good. Only a limited area of the type is found, mostly in one body, though a few very small bodies are also shown in the map. The main area lies about 6 miles southwest of Sherman. Fields of the soil are easily cultivated, and become loamy when handled in the proper condition. The soil, when wet, does not stick to the plow like the Houston black clay.

This type is considered one of the most desirable in the area, partly on account of ease of cultivation and partly because of natural productiveness. It is especially adapted to cotton, corn, wheat, and oats. Cotton gives yields between one-half and three-fourths bale, corn from 35 to 50 bushels, oats 40 to 60 bushels, and wheat from 12 to 20 bushels per acre.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Crawford clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21218	Soil	0.2	0.6	0.6	4.5	11.4	44.4	38.5
21219	Subsoil	.0	.3	.5	4.5	6.4	56.4	31.7

DURANT LOAM.

The surface soil of the Durant loam consists of 10 or 15 inches of dark-gray or grayish-brown loam, containing a relatively high percentage of fine and very fine sand and silt. It is closely associated with the Durant fine sandy loam, almost every area being bordered by this type. There is no sharp demarcation between the soil and subsoil, but the former becomes heavier with depth and passes by degrees into a stiff dark-brown or yellowish-brown silty clay. This material occasionally contains small quantities of fine and very fine sand. The subsoil in the lower lying areas is sometimes mottled and also shows a few spots of reddish-brown iron stains, the result of decomposed iron concretions. At a depth of about 3 feet or more the subsoil occasionally has a reddish tinge. In general the subsoil material is very similar to that of the Durant fine sandy loam, although the latter contains more sand and has a lighter color.

Along the contact between the Durant loam and the Durant fine sandy loam is found a lighter phase of the former. This phase also occurs in the elevated areas. On the other hand, in the more level areas or in depressions the soil frequently approaches a clay loam and contains very little fine sand. The depth of the soil also varies with the topography. In depressions the depth reaches 20 inches, gradually decreasing with the increase of elevation. The accumulation of organic matter is also greater in the depressions.

In topography the Durant loam varies from almost level, its usual condition, to slightly rolling. Even with such topography during an average year the drainage is good, except in occasional small depressions. During wet seasons, however, crops suffer to some extent from excess moisture.

One of the largest areas of Durant loam is found around Redbranch. Other comparatively large areas occur in the vicinity of Whitesboro and Steedman. Scattered areas were mapped throughout the west half of the county.

The Durant loam is considered one of the most productive, if not the most productive, soil in this part of the county. When plowed the soil forms clods, but these are readily pulverized, and the type is not a difficult one to cultivate, and when in good condition forms a mellow, loamy seed bed. The type is well adapted to corn, cotton, and oats. Corn yields from 30 to 45 bushels per acre, cotton about one-half bale, and oats from 35 to 50 bushels. The soil is also a good one for peanuts, potatoes, and fruit, but not so well adapted to these crops as the Durant fine sandy loam.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Durant loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21214	Soil	0.2	0.4	0.4	8.2	15.9	53.6	21.2
21215	Subsoil	.0	1.1	.8	10.1	13.9	51.6	22.3

DURANT FINE SANDY LOAM.

The soil of the Durant fine sandy loam to a depth of 8 to 15 inches is a fine textured sandy loam of a dark-gray color. To about 6 inches the surface material is darker in color than that below, owing to a greater quantity of organic matter, the color gradually becoming lighter and the texture heavier as the depth increases. That portion

just above the subsoil is a dark yellow heavy sandy loam. The subsoil, to a depth of 3 feet, varies from a dull yellow to brown sticky clay, containing some fine sand. Occasionally the subsoil is slightly mottled and stained with iron, where iron concretions have broken down.

Both the soil and subsoil vary in color as also in productiveness with change of topography. The surface ranges from level to gently rolling, and the level areas are darker and have a deeper soil than the higher rolling areas. The soil in the level areas also contains a rather high percentage of silt and very fine sand. The subsoil in such places is generally brown in color, sometimes being slightly mottled and does not contain as much sand as that of other areas of the type. As the elevation increases both the soil and subsoil gradually become lighter in texture and color and the productiveness slightly decreases. The texture of the sand in the more level areas seems to be finer than that in the soil of higher lying areas.

To a certain extent the Durant fine sandy loam has a tendency to drift, thus reducing the depth of the soil in exposed areas, and to build up sandy areas. Occasionally a narrow strip of pure sand, a few yards in width, is formed along the fences.

This type occurs in comparatively large areas in the western part of the county north and south of Whitesboro. There are also some areas in the vicinity of Pottsboro. The largest development is between Whitesboro and Collinsville, where an area 12 miles in length and varying in width from about one-fourth to $3\frac{1}{2}$ miles is mapped.

Owing to its sandy open texture this soil is easily cultivated, any clods that may form in plowing being readily broken down by light harrowing. The soil is well adapted to cotton, corn, and oats, but more especially to fruit. It is on this type that most of the fruit is grown near Whitesboro and Collinsville. It is one of the finest peanut soils in the county. It is also a fine trucking soil, sweet and Irish potatoes and canteloupes producing excellent yields. Corn will yield from 25 to 35 bushels, cotton about one-fourth bale, and peanuts from 35 to 50 bushels per acre. This soil is badly in need of a crop rotation that would increase its organic-matter content. Cowpeas and peanuts can well be grown in connection with corn and cotton, and will be found to be very beneficial. Greater profits can be realized from this soil by growing almost any crop than cotton or corn with the present condition of the soil, but when improved through the addition of humus, these staples will give very satisfactory results.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Durant fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*
21212	Soil	0.3	0.2	0.9	42.8	16.2	33.3	6.5
21213	Subsoil	.0	.2	.4	28.9	12.0	29.1	29.0

TRINITY CLAY.

The Trinity clay consists of 10 to 15 inches of black or occasionally brownish or very dark-yellowish clay, resting on a slightly lighter colored subsoil of practically the same texture, although a little more tenacious, the difference being due to the greater content of organic matter in the top soil.

In Grayson County the soil is not so typically developed as in some other sections of the State where it occurs in wider areas. The type is alluvial in origin, and sometimes it is derived from several kinds of material. It is found principally along the streams flowing through the black-land soils, the principal type being the Houston clay. The materials deposited along these streams comes originally for the most part from the Austin chalk and the Taylor marl, but, immediately, as wash from the soils derived from these formations.

The more typical areas of Trinity clay are found where the bottoms are broadest. Some of the streams along which this type is found have their sources in the sandy soils, which causes the type in places to contain an excess of sand, resulting in a more loamy texture. In such cases the type approaches the conditions described under Meadow.

The Trinity clay as found in Grayson County is somewhat better drained than in other areas mapped. There are some bodies of deficient drainage, but there is almost always fall enough to the streams, which generally flow at levels considerably below the surface of the bottoms, to make drainage easy. The greater proportion of this soil is seldom flooded during the growing season, and the damage to crops is negligible.

Most of this soil is under cultivation. It is especially adapted to alfalfa and corn, and by far the greater part of the alfalfa grown in the county is produced on it. Alfalfa yields from 4 to 5 tons per acre and corn from 40 to 60 bushels. Cotton also does well, but is likely to suffer injury by frost both in the spring and fall.

MEADOW.

The Meadow varies widely, as is frequently the case with alluvial deposits. If mapped in detail the types would fall in the Sanders series. In most cases the surface soil varies from dark brown to nearly black, with occasional grayish areas. The subsoil is usually lighter in color, ranging from gray or drab to dark brown. There is a textural range from fine sand or fine sandy loam through the various classes to clay, the silt content usually running high. These various differences are so complexly arranged that their separation is practically impossible in mapping on a scale of 1 inch to the mile. In the subsoil also there is frequently a lack of uniformity of material, layers of sandy material alternating with silty and clayey layers.

No very broad areas of the type are found in the county. It occurs along all of the streams in the northern half and southwestern section of the county. These streams deposit wash mainly from the Woodbine formation or from the sandy soils.

Spots of Trinity clay are found in the Meadow areas and small areas of Meadow in the Trinity clay, as they occur in this area. The drainage of the type is comparatively good, although artificial drainage would prove very beneficial in places.

The type is easily cultivated, and crops suffer only during wet seasons. It is subject to overflow, but this seldom happens during the growing season.

The Meadow gives especially good results with corn and alfalfa, the yields depending on the season and of course on the textural peculiarities of the individual fields.

ROUGH STONY LAND.

The Rough stony land is found along the smaller streams and near the Red River and has no agricultural value. In many places there are outcrops of rock, generally on the slopes bordering the streams, and the surface is rough and hilly. In some places a forest growth is found, especially in areas close to the streams.

SUMMARY.

Grayson County, comprising an area of 646,400 acres, or 1,010 square miles, lies along the northern border of Texas at the northern limit of the " black land " belt. The surface features vary from rough and broken to level, with the greater proportion gently rolling to rolling.

Denison and Sherman, each with a population between 15,000 and 20,000, are the two most important towns in the county. These towns

have excellent railroad facilities and are the distributing points for jobbing, wholesale, and many other establishments. Whitesboro, Bells, and Whitewright, other important towns, have two railroads, and Howe and Van Alstyne have one. Most of the farmers are located within a reasonable distance of a shipping point, the exception being in the northwestern section of the county.

Farm values have advanced markedly during the last ten or fifteen years, although there has been a slight depression during the last four, the result of poor crops, which have been reduced by abnormal rainfall.

Two rather distinct agricultural sections occur. The heavy soils of the "black-land belt" are especially adapted to cotton, corn, wheat, oats, and alfalfa. In the northern and western parts of the county lighter sandy soils are found. These are better suited to the production of truck and fruit crops, and considerable development has taken place in the production of peaches, berries, potatoes, and peanuts.

Nineteen types of soil occur in the county. These are derived from the Taylor marl, Austin chalk, Woodbine, Eagle Ford, and Fort Worth formations, which are Upper and Lower Cretaceous in age.

The Susquehanna clay occupies a comparatively small area, and the larger part of it is hilly and eroded, which makes it a rather undesirable soil for agriculture.

The Susquehanna fine sandy loam is especially adapted to truck and fruit. At present a large proportion of it is covered by oak forest.

A large part of the Wilson loam is rather rough and eroded, and therefore not a desirable farming soil.

The Wilson clay loam is easily cultivated and adapted to general farming.

The Wilson clay is similar to the Houston black clay, but does not contain as high a percentage of organic matter and is not so productive. Good yields of cotton, corn, and small grain are secured, except in seasons of excessive precipitation.

Most of the Crawford stony clay is too hilly and stony to be easily cultivated, and its principal value is for pasture.

The Miller fine sandy loam—an alluvial soil—ranks among the most productive types in the county. It is especially adapted to alfalfa, although at present the greatest portion of it is used in the production of corn. It is also well adapted to the truck crops.

The Houston clay loam, more easily cultivated than the clay, is also one of the desirable soils, especially for cotton, corn, and small grains.

The Houston black clay, a limestone soil, locally known as "black land," occupies a large area, and is the most important type in the

county. It produces excellent yields of cotton, corn, oats, wheat, and barley, except in abnormally wet seasons.

The Houston clay has the parent limestone generally near the surface, and the areas are hilly and usually eroded. For this reason it is not a very desirable soil for agriculture.

The Houston loam is the result of an intermingling of the materials of Houston black clay and the sandy soils. It is a light-textured soil and well adapted to truck and fruit, while at the same time good for general farming.

The Grayson clay loam generally has poor drainage, and the greater proportion of it is used for grazing.

The Durant fine sand occupies a smaller area than any of the other types. It is unproductive and is of little value for agricultural purposes. It is better adapted to truck than any other crop.

The Crawford clay occupies a very small area. Though heavy, it is friable and handles easily, producing excellent yields of cotton, corn, and small grain.

The Durant loam is adapted to general farming, and at the same time peaches and pears do well on it.

The Durant fine sandy loam, besides being well adapted to general farming, produces good yields of peanuts, truck crops, and peaches. It seems especially adapted to the latter.

Trinity clay and Meadow are found along the small streams. They are of especial value for use in producing alfalfa and corn.

There is a great variety of soils in Grayson County. Many of these are very productive. They also are diversified in character and suited to the production of a wide range of crops. Diversification of products is progressing, the principal departures from the one-crop system being the result of sandy soils suited to trucking and fruit growing. Soils well adapted to alfalfa are encouraging the introduction of this valuable hay crop. The county shows many signs of prosperity and has a bright future.

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Soils Surveyed by
Frank Bennett, Clarence Lounsbury
R T Avon Burke A T Sweet and Percy O'Wood
1909

BASE MAP IN PART FROM
U S GEOLOGICAL SURVEY SHEET

Scale 1 inch - 1 mile

Field Operations
Bureau of Soils
1909

SOIL MAP

TEXAS
GRAYSON COUNTY SHEET

U S DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY CHIEF

LEGEND

- Houston loam — H
- Houston clay loam — Hl
- Houston clay — Hc
- Houston black clay — Hb
- Wilson loam — W
- Wilson clay loam — Wl
- Wilson clay — Wc
- Durant fine sand — Ds
- Durant fine sandy loam — D
- Crawford stony clay loam — C
- Crawford stony clay — Sc
- Crawford clay — C
- Susquehanna fine sandy loam — Sl
- Susquehanna clay — Sc
- Miller fine sandy loam — Mf
- Trinity clay — T
- Meadow — M
- Rock outcrop
- Gravelly areas
- Swampy areas

SOIL PROFILE
(3 feet deep)

- L Loam
- Sc Stony clay
- C Clay loam
- Fs Fine sand
- Fsl Fine sandy loam
- Fs Fine sandy clay
- S Sand
- Stc Silty clay

- Houston loam — L
- Houston clay loam — Cl
- Houston clay — C
- Houston black clay — C
- Wilson loam — L
- Wilson clay loam — Cl
- Wilson clay — C
- Durant fine sand — Fs
- Durant fine sandy loam — Fsl
- Durant loam — L
- Susquehanna fine sandy loam — Sl
- Susquehanna clay — Sc
- Crawford stony clay loam — Cl
- Crawford clay — C
- Miller fine sandy loam — Fsl
- Trinity clay — C
- Crawford stony clay loam — C